CLAIMS

1. A networked force feedback system comprising:

a network;

a first computer coupled to said network, said first computer including a first visual display and a first interface device capable of providing a first computer input, said first interface device including at least one actuator capable of providing force feedback in response to a force feedback signal provided by said first computer, said first computer developing an image on said visual display that is associated with stored force feedback information, wherein said first computer produces said image and said force feedback signal based on information received from a second computer; and

a second computer coupled to said network, said second computer including a second visual display and a second interface device capable of providing a second computer input, said second interface device including at least one actuator capable of providing force feedback in response to a force feedback signal provided by said second computer, said second computer developing an image on said visual display that is associated with stored force feedback information, wherein said second computer produces said image and said force feedback signal based on information received from said first computer.

2. A networked force feedback system as recited in claim 1 wherein said first computer produces said image and said force feedback signal based on information received from a second computer and based on said first computer input, and wherein said second computer produces said image and said force feedback signal based on information received from said first computer and based on said second computer input.

3. A networked force feedback system as recited in claim 1 wherein both said first computer and said second computer are network access computers which communicate over said network using TCP/IP protocols.

4. A networked force feedback system as recited in claim 3 wherein said first computer sends information to a Uniform Resource Locator of said second computer.

5. A networked force feedback system as recited in claim 1 wherein said human/computer interface device coupled to said second computer includes a local microprocessor that communicates with said second computer, a plurality of actuators for

providing a force feedback, and at least one sensor for sensing positions of said human/computer interface device.

6. A networked force feedback system as recited in claim 5 wherein said human/computer interface device coupled to said second computer includes a user manipulatable object for receiving input from said user, said user manipulatable object being movable in two linear degrees of freedom.

7. A networked force feedback system as recited in claim 6 wherein said user manipulatable object is receptive to a finger of said user for manipulating said user manipulatable object in said two linear degrees of freedom.

8. A networked force feedback system as recited in claim 5 wherein said force feedback signal includes a force feedback command that can be parsed by said local microprocessor such that said microprocessor can control said actuators in response to said force feedback command in a control loop with said sensors.

9. A networked force feedback system comprising:

network means;

first computer means coupled to said network means; and

second computer means coupled to said network means, said second computer means including visual display and human/computer interface means, said second computer means further including means for displaying an image on said visual display means, said second computer means further including means for interpreting said visual information and feel sensation information transferred to said second computer means from said first computer means over said network means, displaying said image from said visual information, and associating said feel sensation information with said visual information, said second computer means further including means for developing physical feel sensations at said human/computer interface means using said feel sensation information based on said visual information and a second computer input provided by said human/computer interface means, wherein said physical feel sensations are produced using actuator means included in said human/computer interface means.

10. A networked force feedback system as recited in claim 9 wherein said means for developing physical force feedback uses said feel sensation information in response to a graphical object controlled by said human/computer interface means interacting with a different graphical object of said image.

11. A networked force feedback system as recited in claim 9 wherein both said first computer means and said second computer means are network access computer means which communicate over said network using TCP/IP protocols.

12. A networked force feedback system as recited in claim 9 wherein said means for displaying an image includes means for displaying a graphical environment, wherein said graphical environment includes said visual information transferred from said first computer means to said second computer means.

13. A networked force feedback system as recited in claim 12 wherein said second computer means input comprises at least one of a position input for said human/computer interface device, and a button click input.

14. A networked force feedback system as recited in claim 9 wherein said human/computer interface means coupled to said second computer means includes a local microprocessor means that communicates with said second computer means, a plurality of said actuator means for providing said physical feel sensations, and a plurality of sensor means for sensing positions of said human/computer interface means.

15. A networked force feedback system as recited in claim 14 wherein said second computer means sends a force feedback command to said local microprocessor means that can be parsed by said local microprocessor means such that said microprocessor means can control said actuator means in response to said force feedback command in a control loop with said sensor means.

16. A method for providing force feedback between a first computer and a second computer, the first computer including a first force feedback device providing computer-controlled physical force feedback to a first user of said first force feedback device, the second computer including a visual display and a second force feedback device providing computer-controlled physical force feedback to a second user of said second force feedback device, the method comprising:

establishing a connection between said first computer and said second computer over a network;

developing an image on said visual display of said second computer;

receiving first computer information at said second computer from said first computer over said network;

receiving input information at said second computer from said second force feedback device in response to manipulation of said second force feedback device by said user; and

providing a force feedback signal to said second force feedback device from said second computer, said force feedback signal being based on said first computer information from said first computer and said input information from said second force feedback device, wherein said force feedback signal causes said second force feedback device to output force feedback using an actuator of said second force feedback device.

17. A method as recited in claim 16 wherein said first computer information includes input information from said first force feedback device representing a position of a user manipulatable object of said first force feedback device.

18. A method as recited in claim 17 wherein said first computer information includes force feedback information indicating a force sensation to be output by said second force feedback device.

19. A method as recited in claim 16 further comprising sending second computer information from said second computer to said first computer over said network.

20. A method as recited in claim 19 wherein said second computer information includes said input information from said second force feedback device and force feedback information indicating a force sensation to be output by said first force feedback device.

21. A method as recited in claim 16 wherein said image includes displaying a first graphical object controlled by a user of said first force feedback device, and displaying a second graphical object controlled by a user of said second force feedback device.

22. A method as recited in claim 21 wherein said first and second graphical objects are paddles.

23. A method as recited in claim 21 wherein said first and second graphical objects are displayed in a web page.

24. A method as recited in claim 16 wherein said first force feedback device includes an object representing a body part to be physically contacted by a user.

25. A method as recited in claim 16 wherein said second force feedback device includes a local microprocessor that communicates with said second computer, wherein said local microprocessor parses a force feedback command sent by said second computer such that said local microprocessor can control said actuator in response to said force feedback command in a control loop with at least one sensor of said second force feedback device.

26. A method for allowing two users to interact physically over a computer network, wherein a first manipulandum is physically contacted and moved by a first user in at least one degree of freedom and a second manipulandum is physically contacted and moved by a second user in at least one degree of freedom, the method comprising:

transmitting first information including an indication of said movement of said first manipulandum over said computer network to said second manipulandum physically contacted by said second user;

applying a force to said second manipulandum based on said indication of movement of said first manipulandum such that said second user feels an interaction based on movement of said first manipulandum;

transmitting second information including an indication of movement of said second manipulandum over said computer network to said first manipulandum; and

applying a force to said first manipulandum based on said indication of movement of said second manipulandum such that said first user feels an interaction based on movement of said second manipulandum.

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27. A method as recited in claim 26 wherein said first and second manipulandums are coupled to first and second computers, respectively, that are coupled to said computer network.

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28. A method as recited in claim 27 further comprising developing an image on a visual display of said first and second computers, said image portraying a graphical environment at least partially responsive to said movement of said first manipulandum or said second manipulandum.

29. A method as recited in claim 28 wherein said graphical environment includes a first graphical object controlled by said first manipulandum and a second graphical object controlled by said second manipulandum, and wherein when said first and second graphical objects interact in said graphical object, forces are applied to said first manipulandum and said second manipulandum.

30. A method as recited in claim 27 wherein at least one of said first and second manipulandums represents a body part.

31. A method as recited in claim 27 wherein each of said first and second information includes feel sensation information indicating a type of force sensation to be output.

32. A method as recited in claim 31 wherein said feel sensation information includes a command to overlay a designated feel sensation on a different feel sensation that is simultaneously output.

33. A method as recited in claim 27 wherein said first manipulandum and said second manipulandum are each included in a force feedback device, said force feedback device including a local microprocessor parsing commands from one of said first and second computers.

34. A method as recited in claim 33 wherein said force feedback devices each include at least one sensor for determining a position of said manipulandum of said force feedback device, and at least one actuator for outputting a force in a degree of freedom of said manipulandum of said force feedback device.

35. A method for providing force feedback between a first computer and a second computer, the first computer including a first force feedback device providing computer-controlled physical force feedback to a first user of said first force feedback device, the second computer including a visual display and a second force feedback device providing computer-controlled physical force feedback to a second user of said second force feedback device, the method comprising:

establishing a connection between said first computer and said second computer over a network;

sending first computer information to said second computer from said first computer over said network;

providing a force feedback signal to said second force feedback device from said second computer, said force feedback signal being based on said first computer information, wherein said force feedback signal causes said second force feedback device to output forces to said second user using an actuator of said second force feedback device;

sending second computer information to said first computer from said second computer over said network;

providing a force feedback signal to said first force feedback device from said first computer, said force feedback signal being based on said second computer information, wherein said force feedback signal causes said first force feedback device to output forces to said first user using an actuator of said first force feedback device.

36. A method as recited in claim 35 wherein said first computer receives input information from said first force feedback device in response to manipulation of said first force feedback device by said first user, and wherein said second computer receives input information from said second force feedback device in response to manipulation of said second force feedback device by said second user.

37. A method as recited in claim 36 wherein said force feedback signal from said first and second computers is based on said input information from said first and second force feedback devices, respectively.

38. A method as recited in claim 35 wherein said first computer information includes position information describing a position of a manipulandum of said first force feedback device, and wherein said second computer information includes position information describing a position of a manipulandum of said second force feedback device.

39. A method as recited in claim 38 wherein said first computer information includes force feedback information indicating a force sensation to be output by said second force feedback device, and wherein said second computer information includes force feedback information indicating a force sensation to be output by said second force feedback device.

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40. A method as recited in claim 39 wherein said first and second computers each display a graphical environment having a first graphical object controlled by said first user and a second graphical object controlled by said second user.

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41. A method as recited in claim 35 wherein said first and second computers communicate using a TCP/IP protocol.

42. A method as recited in claim 35 further comprising accessing a server computer with one of said first and second computers and downloading feel sensation information from said server computer, said feel sensation information to be included in said first computer information or said second computer information.

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43. A method as recited in claim 42 wherein said server computer provides a web page downloaded to said computer accessing said server, said web page including embedded feel sensation information.

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